US009505118B2

(12) **United States Patent**
Furusawa et al.

(10) **Patent No.: US 9,505,118 B2**
(45) **Date of Patent: Nov. 29, 2016**

(54) **STRIKING TOOL**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 808 days.

(21) Appl. No.: **13/263,027**

(22) PCT Filed: **Apr. 9, 2010**

(86) PCT No.: **PCT/JP2010/056459**
§ 371 (c)(1),
(2), (4) Date: **Nov. 7, 2011**

(87) PCT Pub. No.: **WO2010/117063**
PCT Pub. Date: **Oct. 14, 2010**

(65) **Prior Publication Data**

US 2012/0067605 A1 Mar. 22, 2012

(30) **Foreign Application Priority Data**

Apr. 10, 2009 (JP) 2009-096498

(51) **Int. Cl.**
B25D 17/24 (2006.01)
B25D 17/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B25D 17/24*** (2013.01); ***B25D 17/043*** (2013.01); *B25D 2211/003* (2013.01); *B25D 2222/57* (2013.01); *B25D 2250/121* (2013.01); *B25D 2250/371* (2013.01)

(58) **Field of Classification Search**
CPC .. B25D 17/24; B25D 17/043; B25D 17/046; B25D 17/00
USPC 173/162.1, 162.2, 210
See application file for complete search history.

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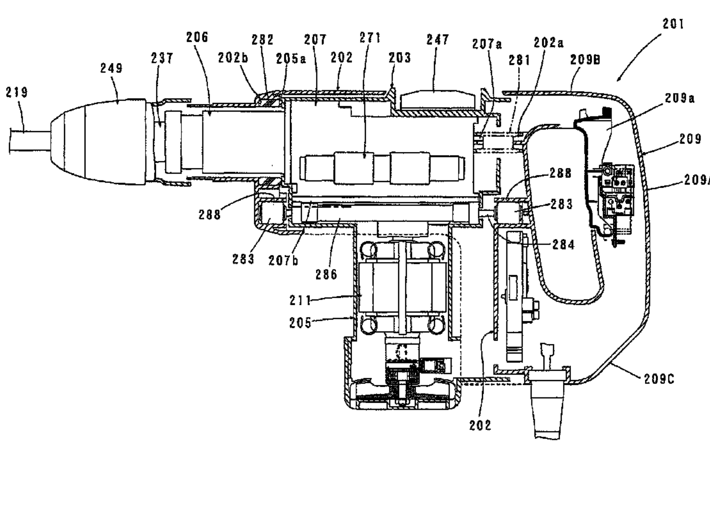
(57) **ABSTRACT**

A technique for improving the vibration-proof effect and usability of a handle is provided in an impact tool. An impact tool is provided which linearly drives a tool bit in an axial direction thereof to cause the tool bit to perform a predetermined hammering operation. The impact tool includes a motor, a striking mechanism part, that is driven by the motor and causes the tool bit to linearly move, a tool body that houses the motor and the striking mechanism part, an outer shell housing that covers at least part of the tool body and is connected to the tool body via a vibration-proofing first elastic element so as to be movable in a direction transverse to the axial direction of the tool bit with respect to the tool body, and a handle which is designed to be held by a user and connected to an opposite side of the outer shell housing from the tool bit via a vibration-proofing second elastic element so as to be movable in the axial direction of the tool bit with respect to the outer shell housing.

9 Claims, 14 Drawing Sheets



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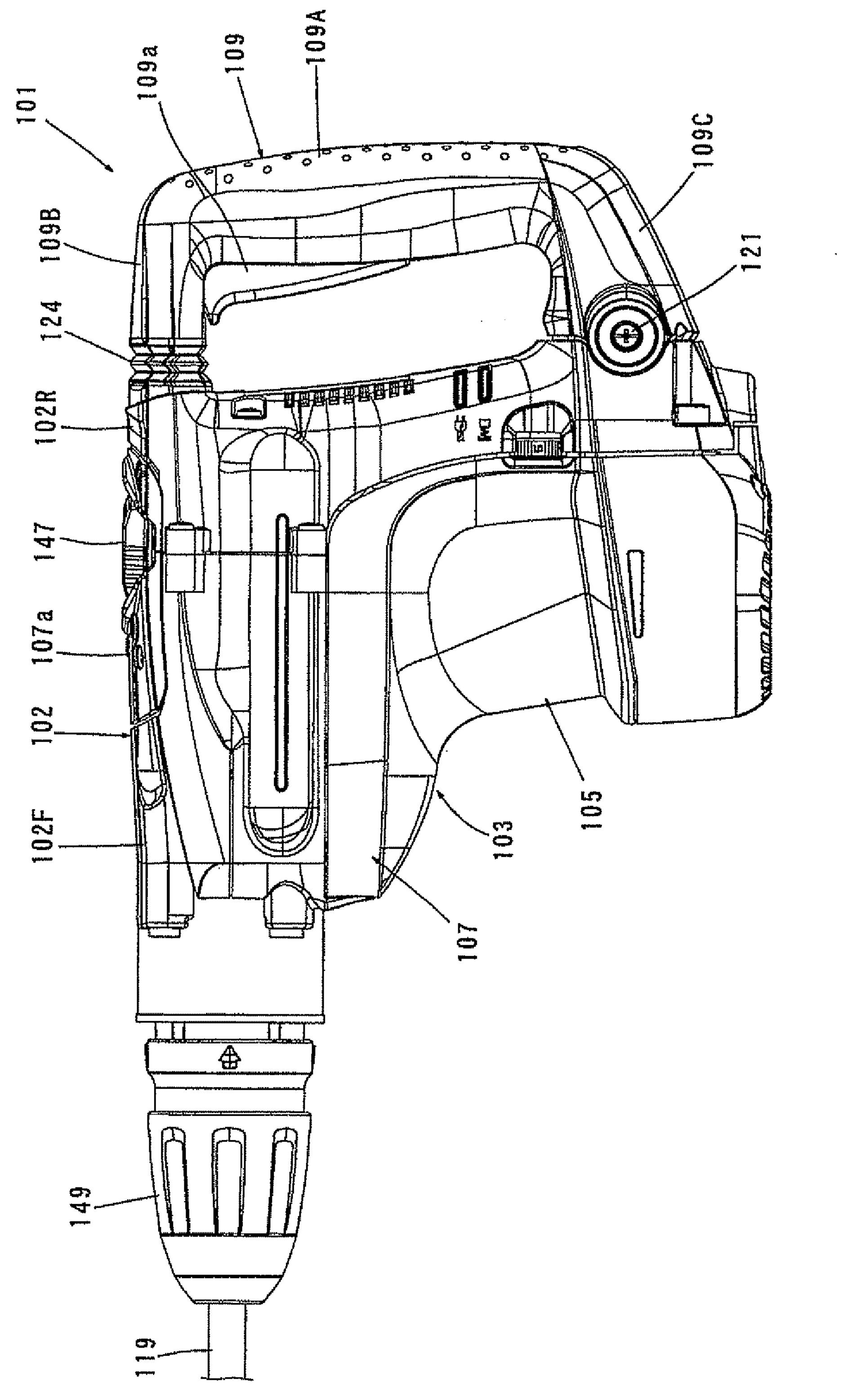
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FIG. 1

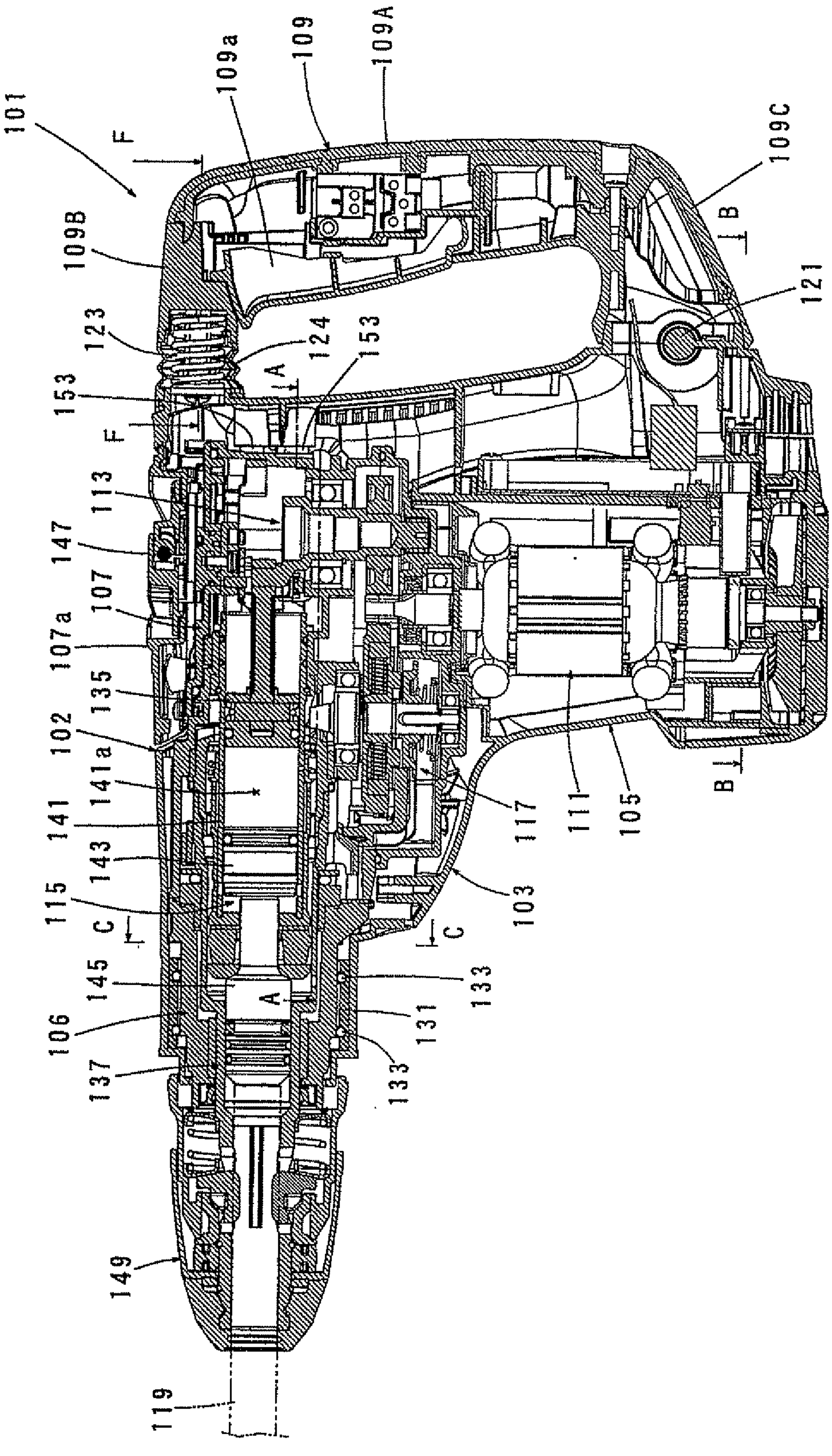
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FIG. 2

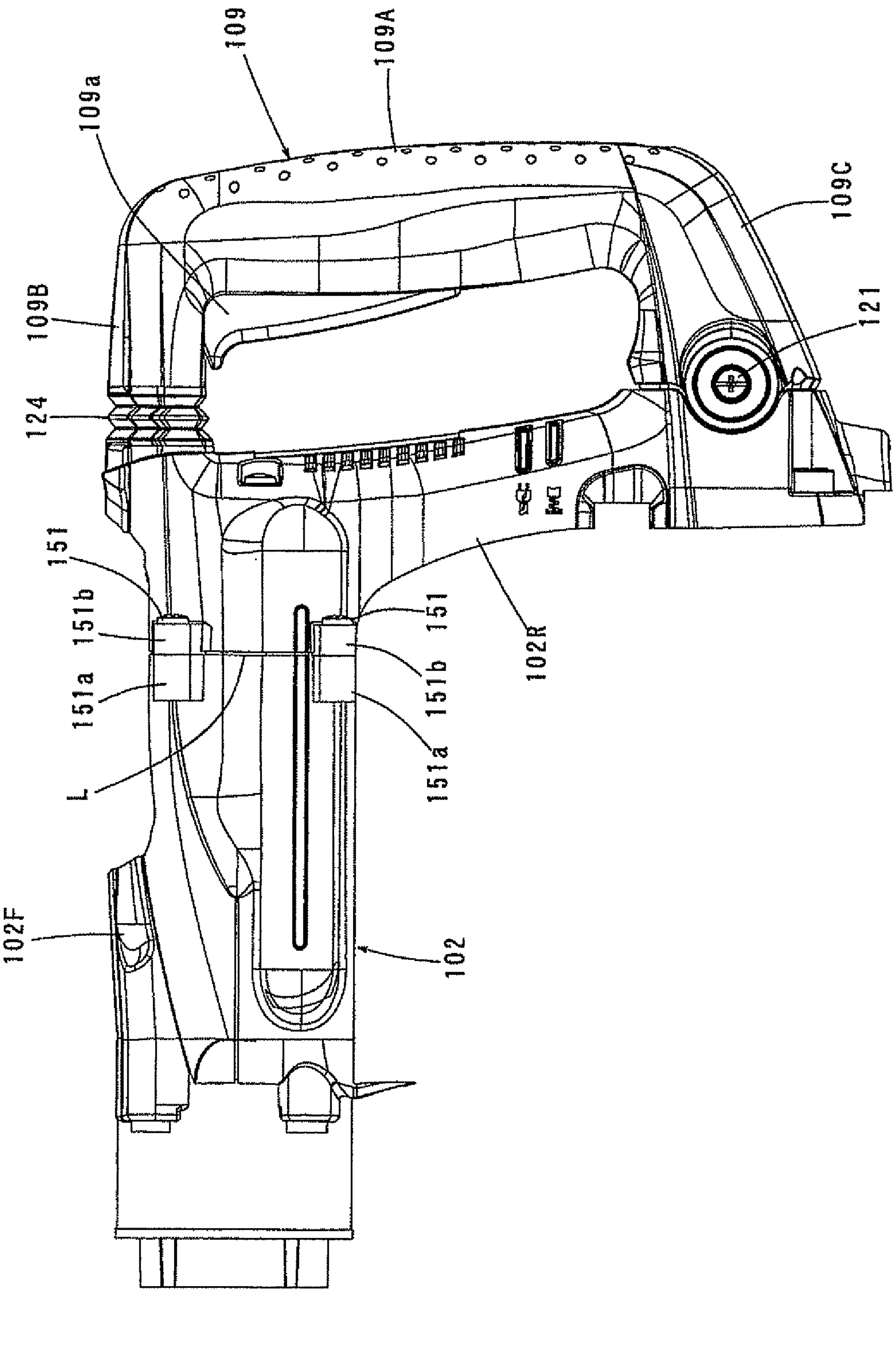
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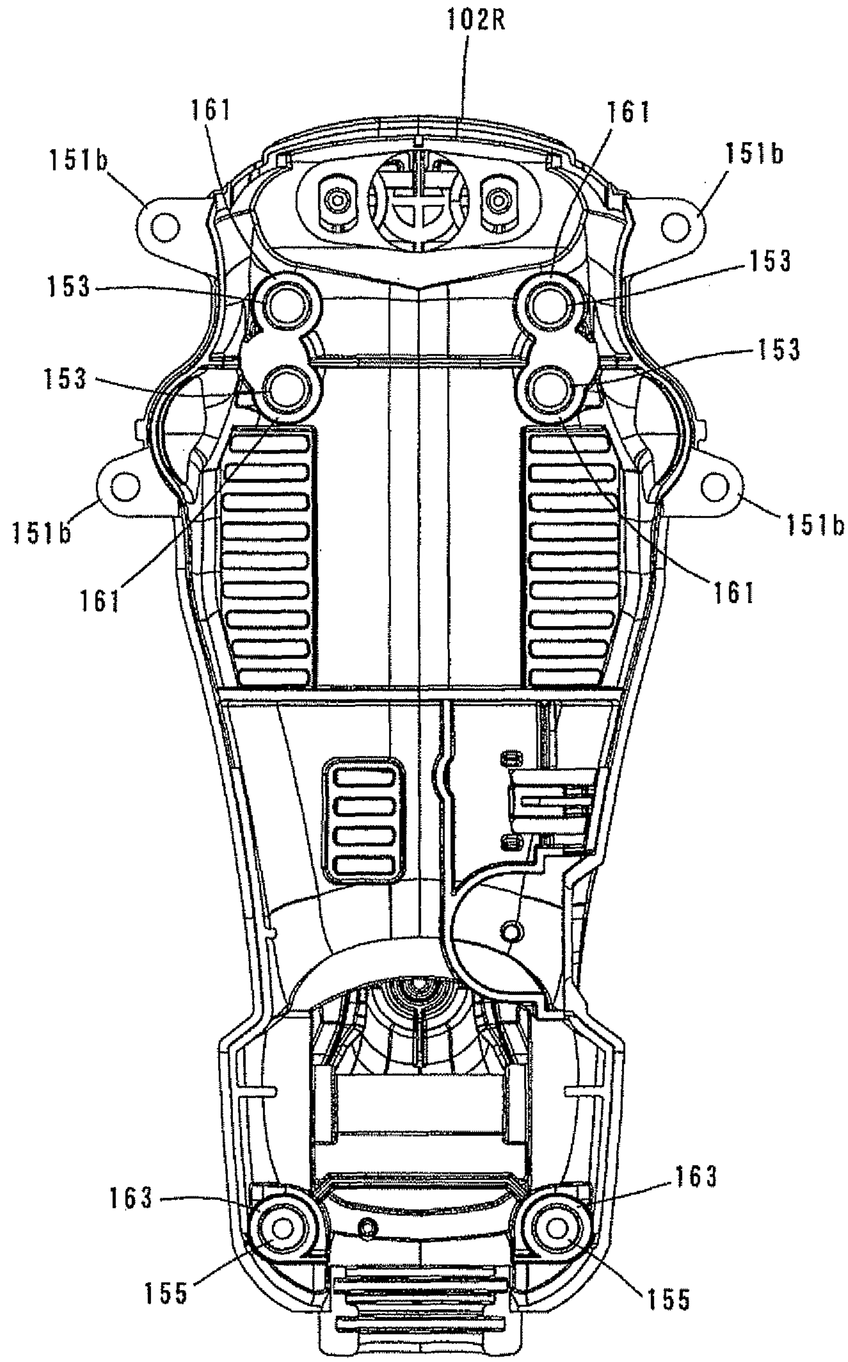
FIG. 3

FIG. 4



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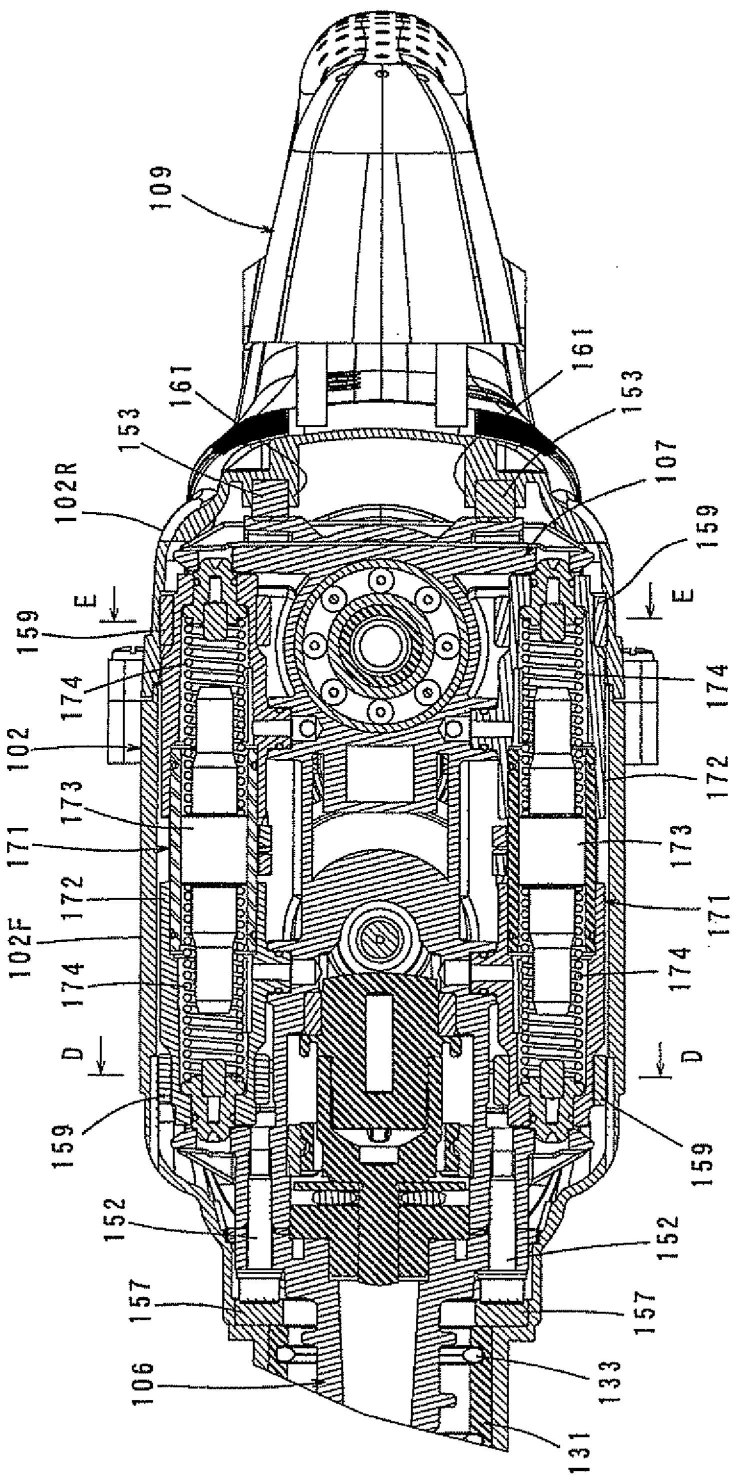
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FIG. 5

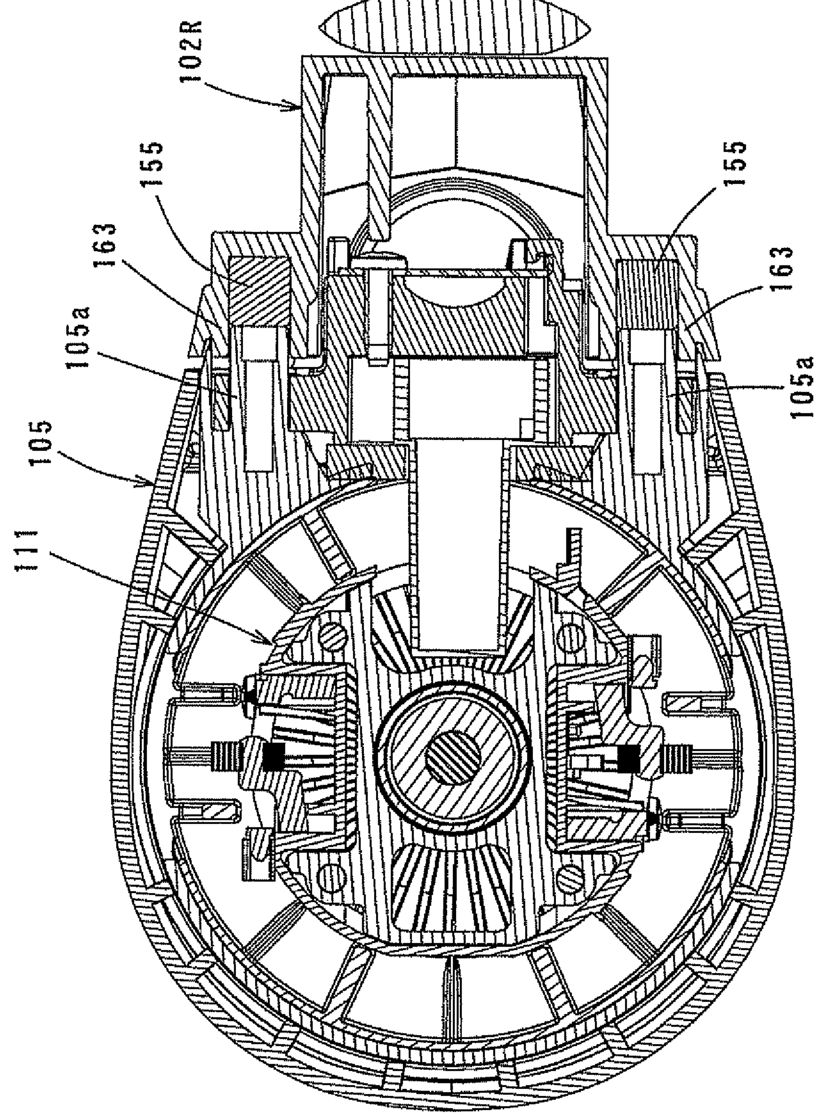

FIG. 6

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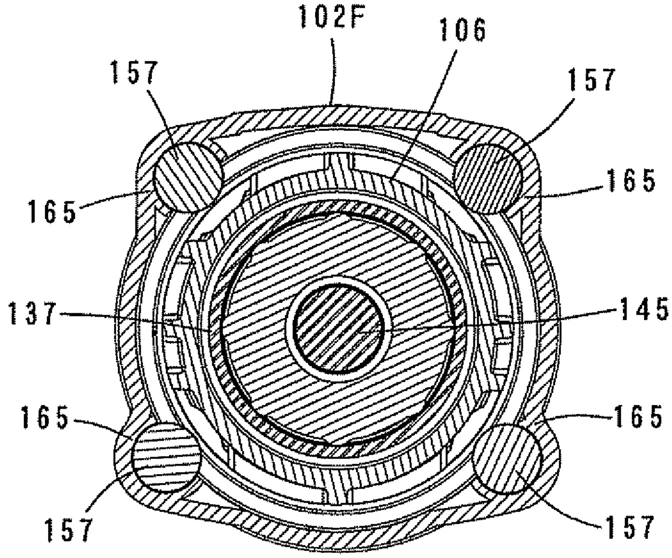
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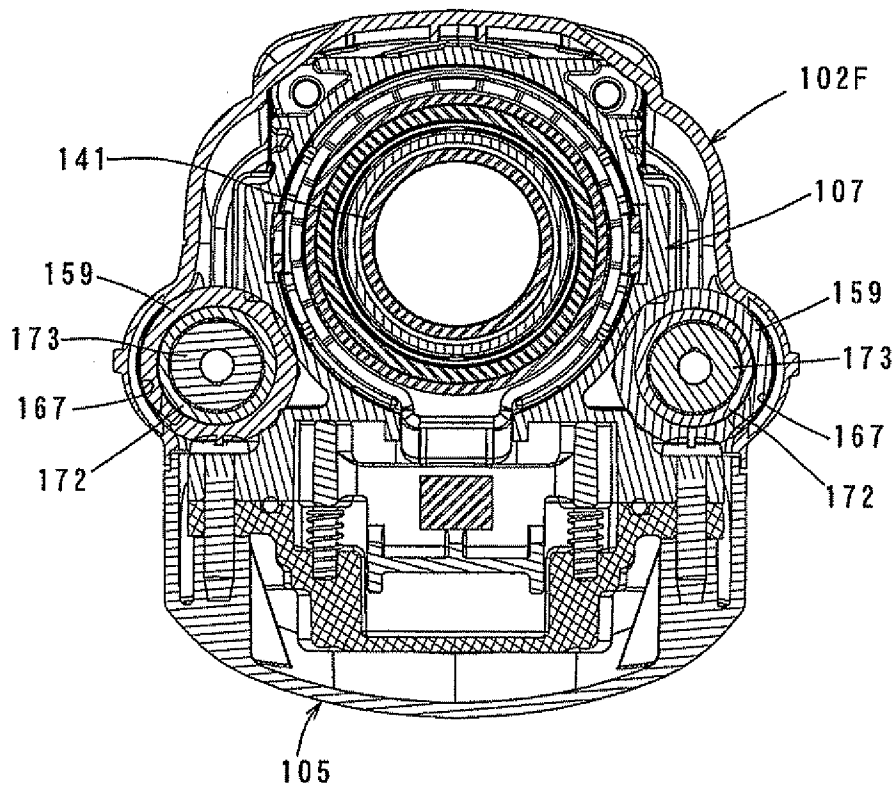
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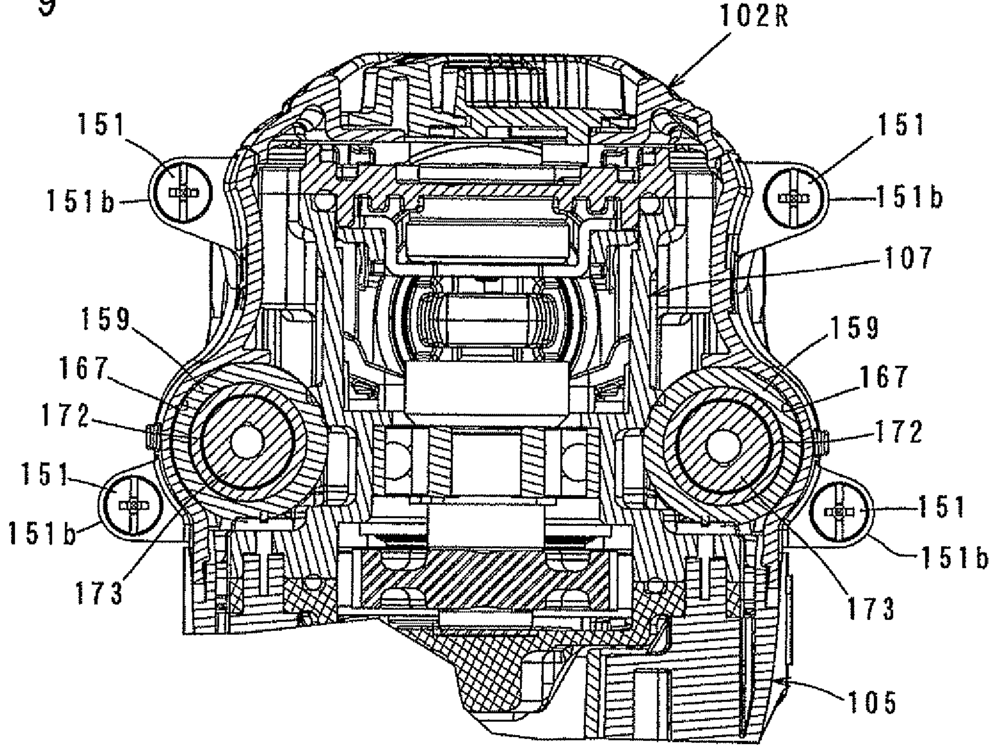
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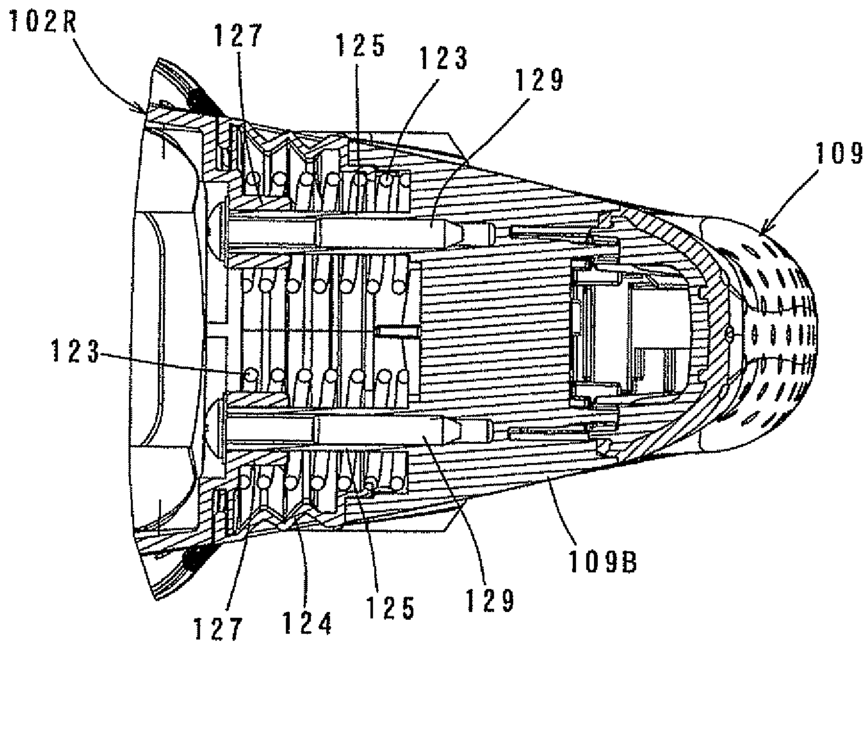
FIG. 10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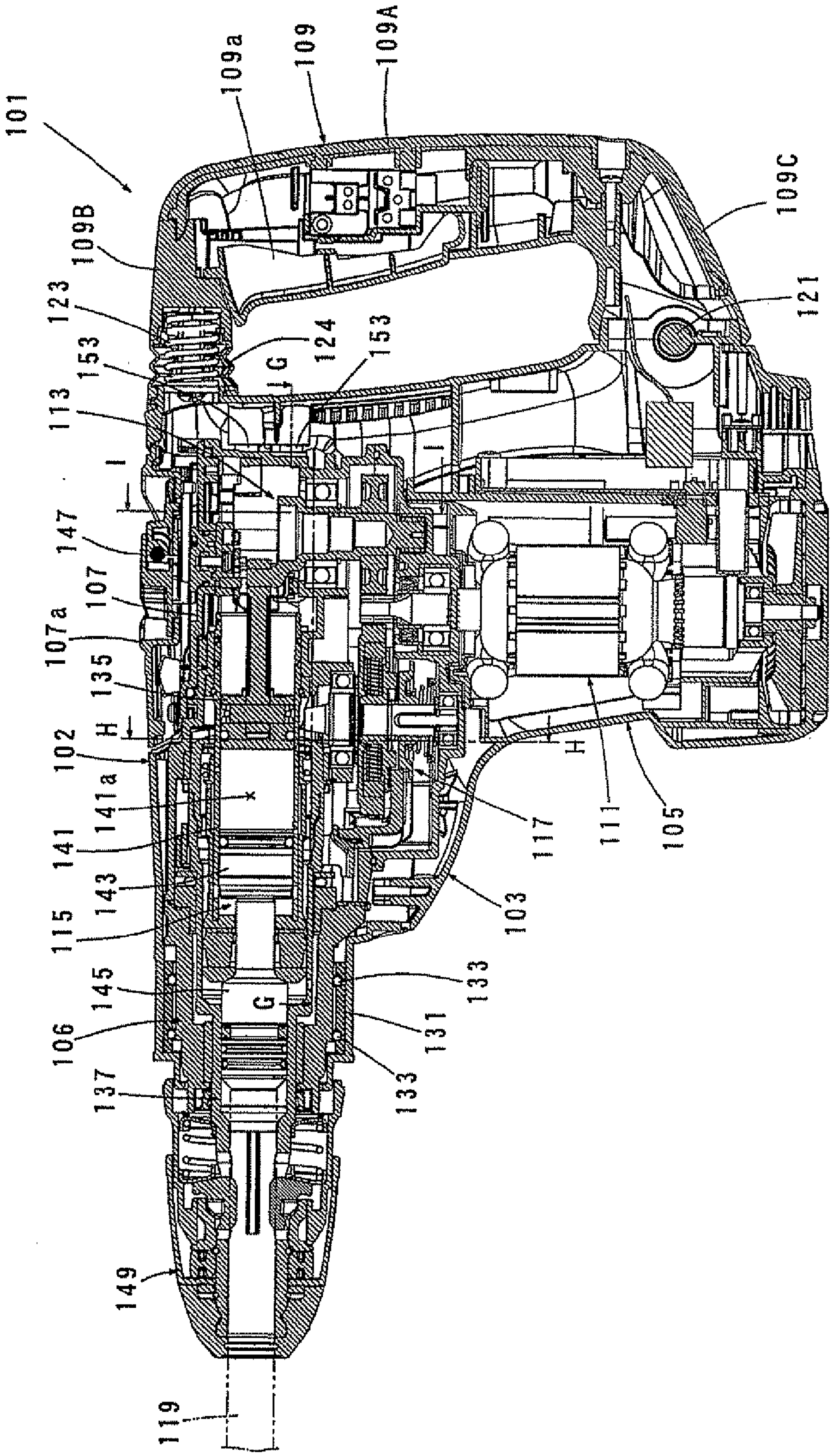
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FIG. 11

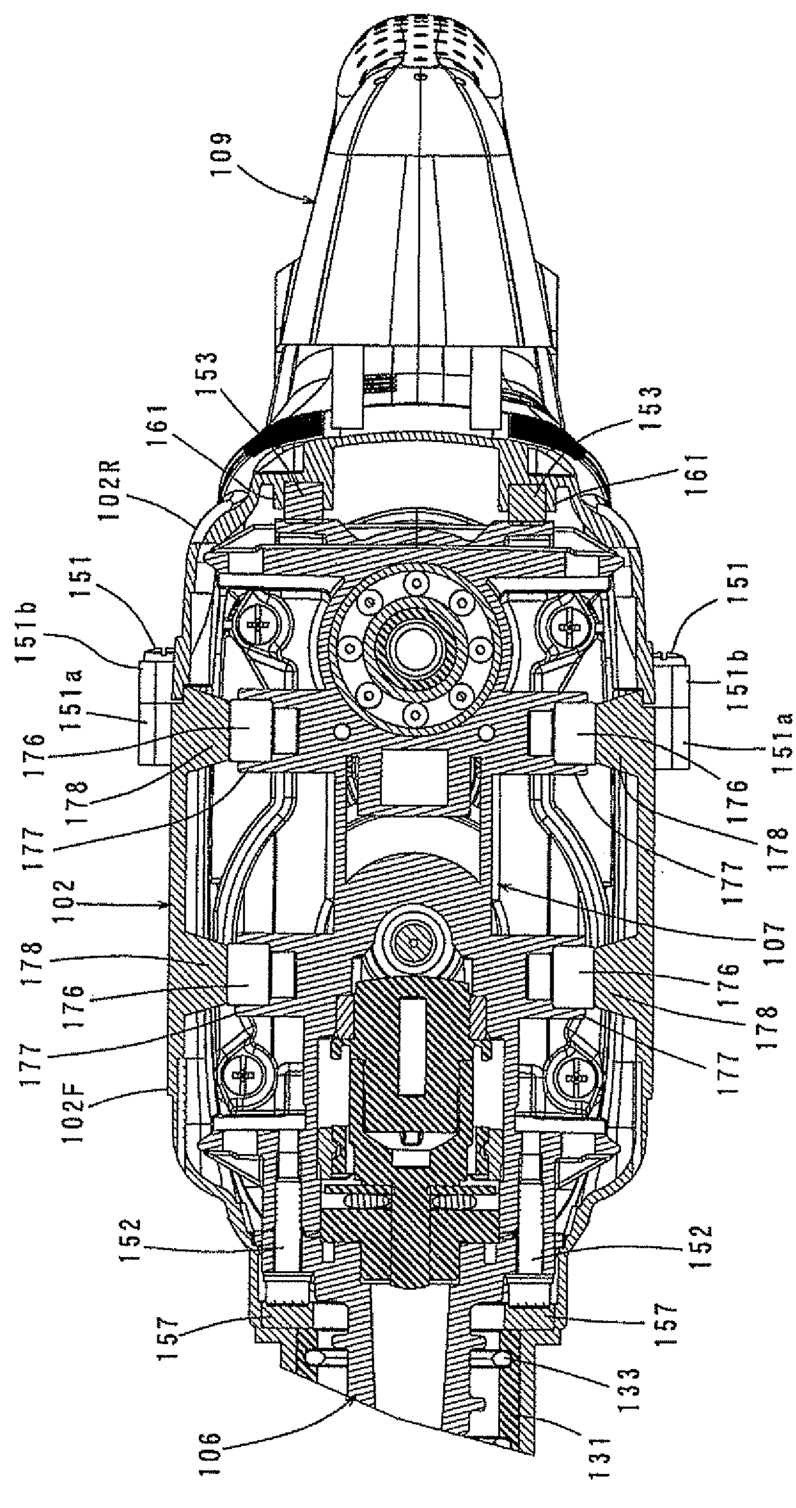
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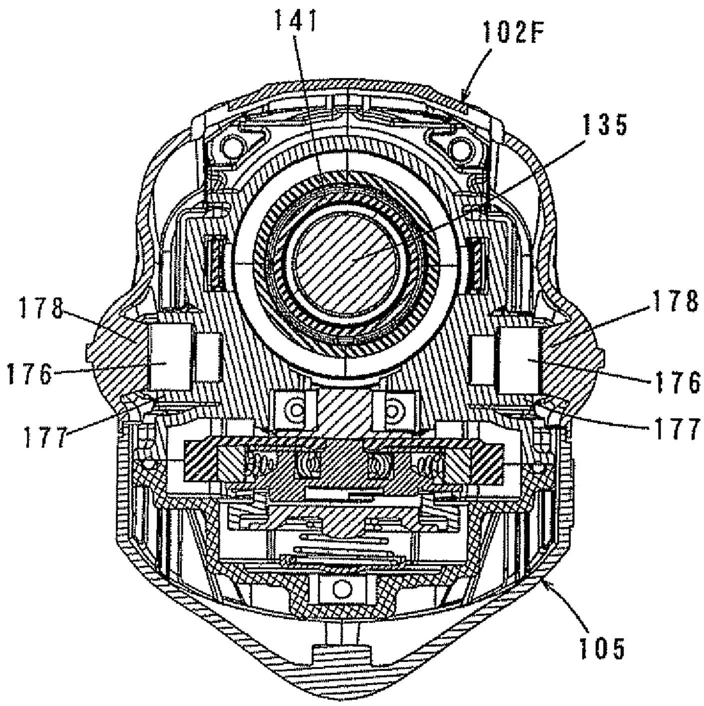
FIG. 12

FIG. 13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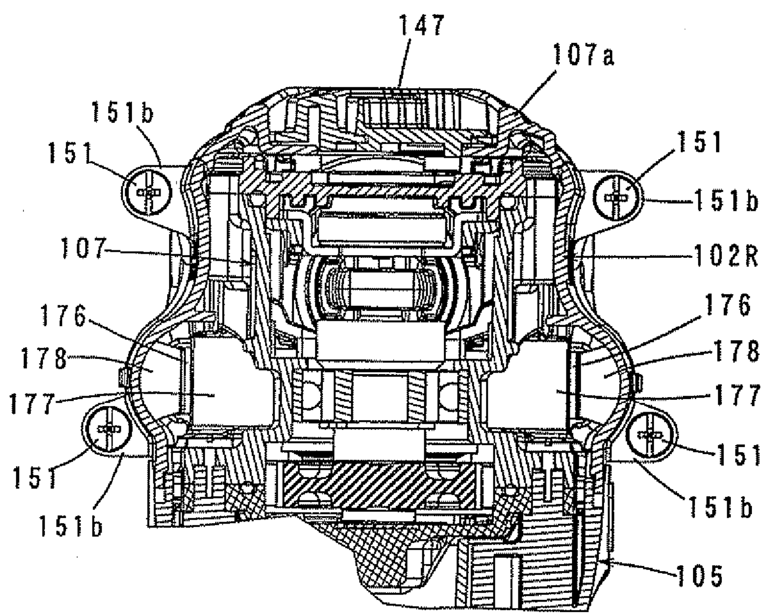
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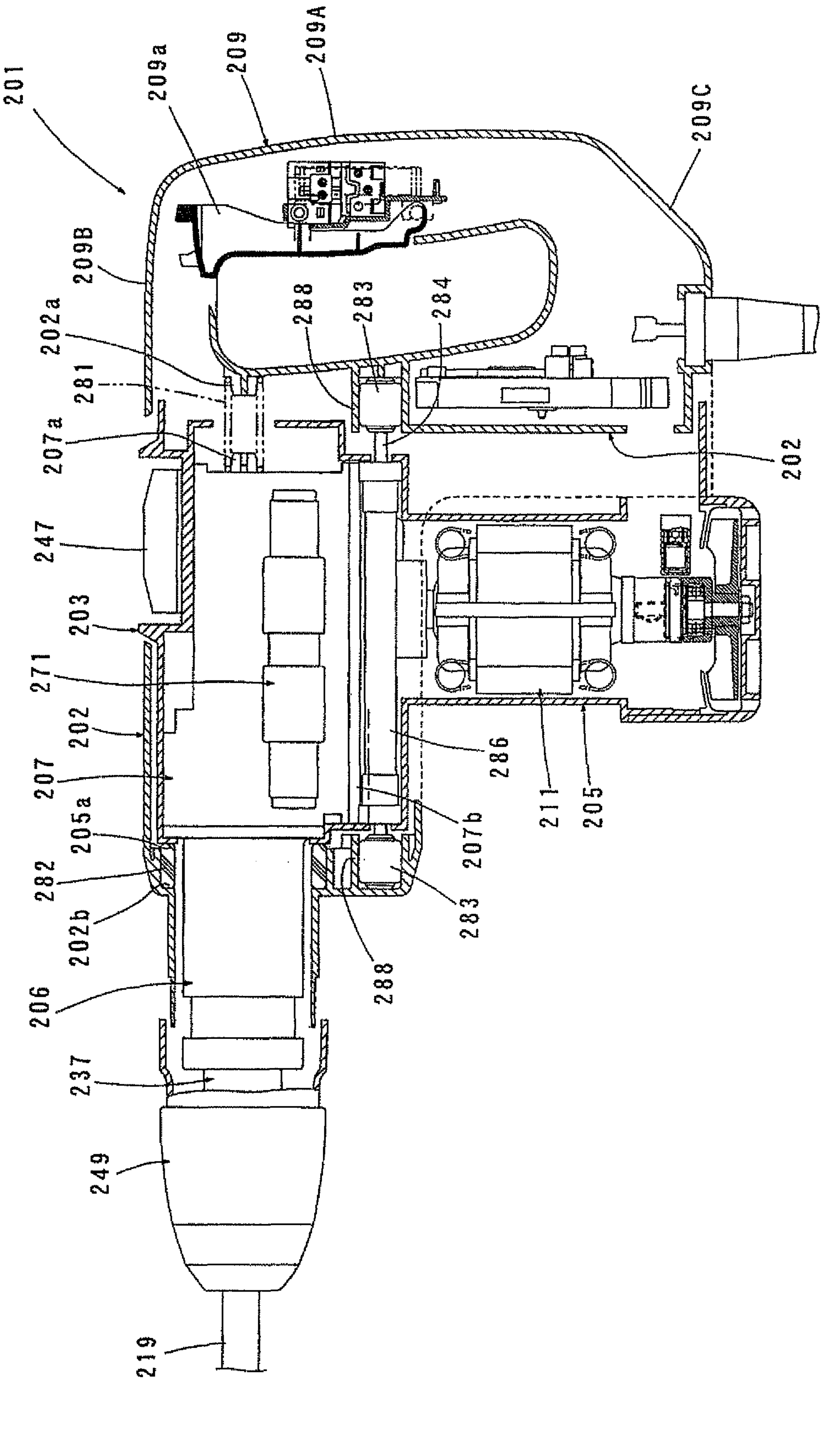
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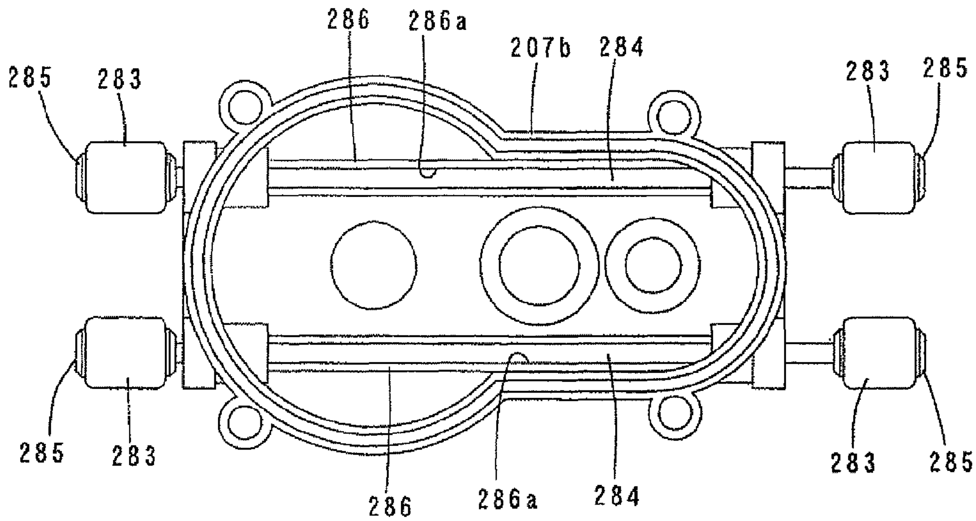
FIG. 15

FIG. 16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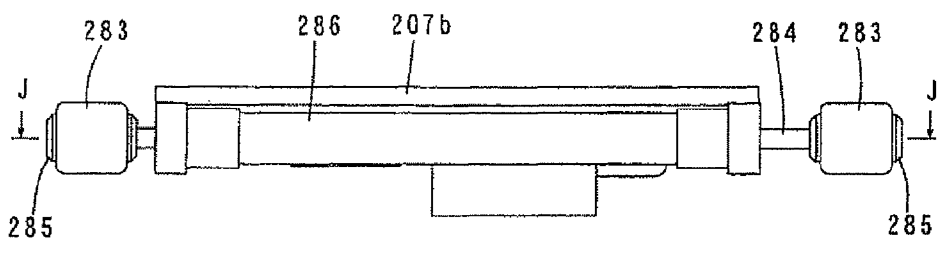
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FIG. 18

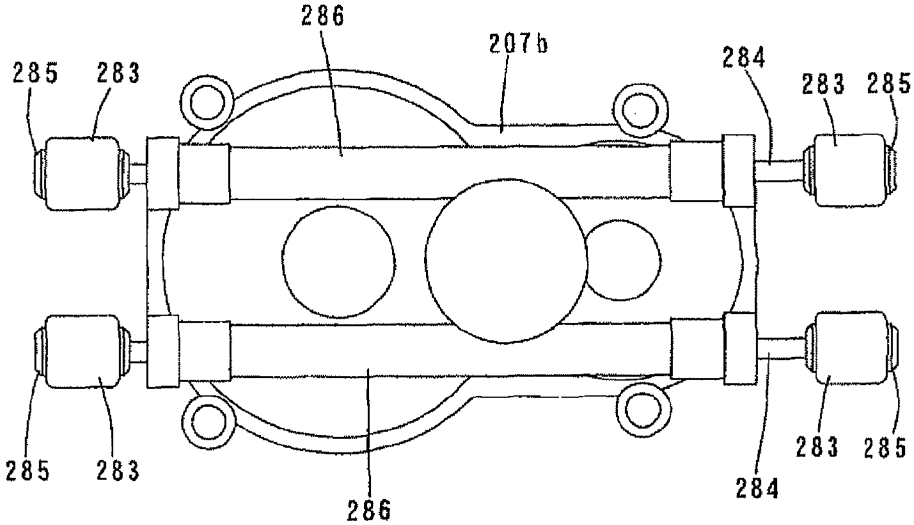
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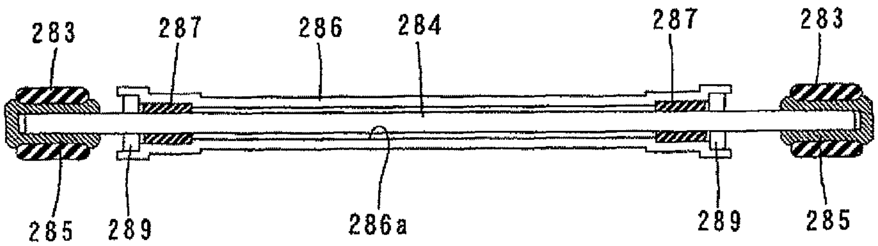
FIG. 19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STRIKING TOOL

FIELD OF THE INVENTION

The present invention relates to a vibration-proofing technique in a striking impact tool.

BACKGROUND OF THE INVENTION

Japanese Patent No. 3520130 discloses an electric hammer in which a housing integrally provided with a handle is connected to a striking mechanism part for striking a hammer bit, via an elastic element.

During operation using an electric hammer, vibration is caused in a striking mechanism part of the hammer not only in an axial direction of a tool bit in which the tool bit performs striking movement, but also in a direction transverse to the axial direction. Therefore, a technique is desired which can prevent vibration in various directions.

DISCLOSURE OF THE INVENTION

Object to be Achieved by the Invention

Accordingly, it is an object of the present invention to provide an impact tool in which the vibration-proof effect and usability of a handle are further improved.

Means for Achieving the Object

In order to achieve the above-described object, according to a preferred embodiment of the present invention, an impact tool is provided which linearly drives a tool bit in an axial direction of the tool bit to cause the tool bit to perform a predetermined hammering operation. The "impact tool" in this invention is not limited to a hammer in which a tool bit is caused to linearly move in the axial direction, and also suitably includes a hammer drill in which a tool bit is caused to linearly move in the axial direction and rotate around its axis.

The impact tool according to this invention is characterized in that it includes a motor, a striking mechanism part which is driven by the motor and causes the tool bit to linearly move, a tool body which houses the motor and the striking mechanism part, an outer shell housing which covers at least part of the tool body, a first elastic element which elastically connects the outer shell housing to the tool body such that the outer shell housing can move in a direction transverse to the axial direction of the tool bit with respect to the tool body, a handle designed to be held by a user, and a second elastic element which connects the handle to the outer shell housing such that the handle can move in the axial direction of the tool bit with respect to the tool body.

The "striking mechanism part" in this invention typically includes a motion converting mechanism which converts torque of the motor into linear motion, and a striker which is linearly driven via pressure fluctuations (air spring action) caused by this linear motion and strikes the tool bit. Further, the "first elastic element" and the "second elastic element" in this invention represent a spring or rubber.

According to this invention, as for vibration caused in the tool body that houses the striking mechanism part which is a vibrating source, vibration in the axial direction (the striking direction) of the tool bit is reduced by the second elastic element which connects the outer shell housing and the handle, while vibration in a direction transverse to the

axial direction is reduced by the first elastic element which connects the tool body and the outer shell housing. Thus, by individually setting stiffness (spring constant) of the first and second elastic elements, the handle is made proof against vibration not only in the axial direction but also in a direction transverse to the axial direction. Furthermore, the handle can be prevented from wobbling in a direction transverse to the axial direction. Thus, usability of the handle can be improved.

According to a further embodiment of the impact tool of the present invention, the handle has a grip region extending in a direction transverse to the axial direction of the tool bit and one end of the grip region in an extending direction is connected to the outer shell housing by the second elastic element comprising a mechanical spring. In the case of an impact tool, the user holds the handle and performs an operation while applying a pressing force to the handle in a direction to press the tool bit against a workpiece. Therefore, by provision of the construction like in the present invention in which the grip region of the handle extends in a direction transverse to the axial direction of the tool bit, the operation of pressing the tool bit can be easily performed.

According to a further embodiment of the impact tool of the present invention, the outer shell housing is split into a plurality of split elements in the axial direction of the tool bit and formed by connecting the split elements to each other. According to this invention, when a plurality of split elements are clamped and connected together, for example, by screws, the split elements can be easily assembled together, with the first elastic element held between the outer shell housing and the tool body, so that ease of assembling the split elements is improved.

According to a further embodiment of the impact tool of the present invention, the tool body has a cylindrical barrel extending in the axial direction of the tool bit. Further, an O-ring is disposed between an outer circumferential surface of the barrel and an inner circumferential surface of the outer shell housing which covers the barrel, and the tool body and the outer shell housing are positioned in a radial direction by the O-ring. Further, the "radial direction" in this invention refers to a direction transverse to the axial direction of the tool bit.

According to this invention, the O-ring can serve as the first elastic element which connects the outer shell housing to the tool body.

In order to solve the above-described problem, according to a different embodiment of the present invention, an impact tool is provided which linearly drives a tool bit in an axial direction thereof to cause the tool bit to perform a predetermined hammering operation. Further, the "impact tool" in this invention is not limited to a hammer in which a tool bit is caused to linearly move in the axial direction; and also suitably includes a hammer drill in which a tool bit is caused to linearly move in the axial direction and rotate around its axis.

The impact tool according to this invention is characterized in that it includes a motor, a striking mechanism part which is driven by the motor and causes the tool bit to linearly move, a tool body which houses the motor and the striking mechanism part, an outer shell housing which covers at least part of the tool body, and a handle which is designed to be held by a user and integrally formed on an opposite side of the outer shell housing from the tool bit. The outer shell housing is connected to the tool body via at least a first elastic element which can elastically deform in a direction transverse to the axial direction of the tool bit and a second elastic element which can elastically deform in the axial direction of the tool bit. Further, the "striking mechanism part" in this invention typically includes a motion converting mechanism which converts torque of the motor into linear motion, and a striker which is linearly driven via pressure fluctuations (air spring action) caused by the linear motion of the motion converting mechanism and strikes the tool bit. The manner of "being integrally formed" in this invention suitably includes the manner in which the outer shell housing and the handle are integrally formed with each other or the manner in which the outer shell housing and the handle are separately formed and thereafter fixed to each other. Further, the "first elastic element" and the "second elastic element" in this invention represent a spring or rubber.

According to this invention, when the user holds the handle of the impact tool and performs an operation, as for vibration which is caused in the striking mechanism part and transmitted to the outer shell housing, vibration in the axial direction of the tool bit is prevented by the second elastic element, while vibration in a direction transverse to the axial direction of the tool bit is prevented by the first elastic element. Therefore, by individually setting stiffness (spring constant) of the first and second elastic elements, the handle is made proof against vibration not only in the axial direction but also in a direction transverse to the axial direction. Furthermore, the handle can be prevented from wobbling in a direction transverse to the axial direction. Thus, usability of the handle can be improved.

According to a further embodiment of the impact tool of the present invention, in the impact tool in which the handle is integrally formed with the outer shell housing, a rod-like member is provided in the tool body and slidably extends through the tool body in the axial direction of the tool bit. The rod-like member serves as a guide rail for guiding movement of the outer shell housing in the axial direction of the tool bit with respect to the tool body. With such a construction, movement of the outer shell housing in the axial direction of the tool bit with respect to the tool body can be stabilized, so that usability of the handle can be improved.

In a further embodiment of the impact tool of the present invention, the rod-like member and the outer shell housing are connected to each other via the first elastic element. Thus, a vibration-proofing structure for preventing vibration of the outer shell housing and the handle in a direction transverse to the axial direction of the tool bit can be rationally formed by the first elastic element.

In a further embodiment of the impact tool of the present invention, a dynamic vibration reducer for reducing vibration of the outer shell housing in the axial direction of the tool bit is provided in the outer shell housing. According to this invention, vibration in the axial direction of the tool bit which cannot be fully prevented by the second elastic element can be further reduced by the vibration reducing function of the dynamic vibration reducer.

Effect of the Invention

According to this invention, a technique for improving the vibration-proof effect and usability of a handle is provided in an impact tool.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an external view showing an entire structure of a hammer drill according to a first embodiment of the present invention.

FIG. **2** is a sectional view showing an internal structure of the hammer drill.

FIG. **3** is an external view showing an outer housing and a handgrip connected to the outer housing of the hammer drill.

FIG. **4** shows a rear housing part of the outer housing which is split in a longitudinal direction, as viewed from the front (the hammer bit side).

FIG. **5** is a sectional view taken along line A-A in FIG. **2**.

FIG. **6** is a sectional view taken along line B-B in FIG. **2**.

FIG. **7** is a sectional view taken along line C-C in FIG. **2**.

FIG. **8** is a sectional view taken along line D-D in FIG. **5**.

FIG. **9** is a sectional view taken along line E-E in FIG. **5**.

FIG. **10** is a sectional view taken along line F-F in FIG. **2**.

FIG. **11** is a sectional view showing an entire structure of a hammer drill according to a second embodiment of the present invention.

FIG. **12** is a sectional view taken along line G-G in FIG. **11**.

FIG. **13** is a sectional view taken along line H-H in FIG. **11**.

FIG. **14** is a sectional view taken along line I-I in FIG. **11**.

FIG. **15** is a sectional view showing an entire structure of a hammer drill according to a third embodiment of the present invention.

FIG. **16** is a planar view illustrating a bottom plate of a crank housing and a vibration-proofing structure which is provided for the outer housing on the bottom plate.

FIG. **17** is a side view of FIG. **16**.

FIG. **18** is a bottom view of FIG. **16**.

FIG. **19** is a sectional view taken along line in FIG. **17**.

REPRESENTATIVE EMBODIMENT OF THE INVENTION

First Embodiment of the Invention

A first embodiment of the present invention is now described with reference to FIGS. **1** to **10**. This embodiment corresponds to the features as defined in claims **1** to **4**. In this embodiment, an electric hammer drill is explained as a representative example of an impact tool. As shown in FIGS. **1** and **2**, a hammer drill **101** according to this embodiment mainly includes an outer housing **102** that forms an outer shell of the hammer drill **101**, a body **103** that is covered by the outer housing **102**, a hammer bit **119** that is detachably coupled to a front end region (on the left as viewed in the drawings) of the body **103** via a hollow tool holder **137**, and a handgrip **109** that is connected to the outer housing **102** on the side opposite from the hammer bit **119** and designed to be held by a user. The hammer bit **119** is held by the tool holder **137** such that it is allowed to linearly move with respect to the tool holder in its axial direction. The outer housing **102**, the body **103**, the hammer bit **119** and the handgrip **109** are features that correspond to the "outer shell housing", the "tool body", the "tool bit" and the "handle", respectively, according to the present invention. Further, for the sake of convenience of explanation, the side of the hammer bit **119** is taken as the front and the side of the handgrip **109** as the rear.

As shown in FIG. **2**, the body **103** includes a motor housing **105** that houses a driving motor **111**, and a crank housing **107** including a barrel **106** that houses a motion converting mechanism **113**, a striking mechanism **115** and a power transmitting mechanism **117**. The driving motor **111** is disposed such that its rotation axis runs in a vertical direction (vertically as viewed in FIG. **3**) substantially perpendicular to a longitudinal direction of the body **103** (an axial direction of the hammer bit **119**). The motion converting mechanism **113** appropriately converts torque of the driving motor **111** into linear motion and then transmits it to the striking mechanism **115**. Then an impact force is generated in the axial direction of the hammer bit **119** (the horizontal direction as viewed in FIG. **1**) via the striking mechanism **115**. The motion converting mechanism **113** and the striking mechanism **115** are features that correspond to the "striking mechanism part" according to this invention. Further, the power transmitting mechanism **117** appropriately reduces the speed of torque of the driving motor **111** and transmits it to the hammer bit **119** via the tool holder **137**, so that the hammer bit **119** is caused to rotate in its circumferential direction. The driving motor **111** is driven when a user depresses a trigger **109***a* disposed on the handgrip **109**.

The motion converting mechanism **113** mainly includes a crank mechanism. The crank mechanism includes a driving element in the form of a piston **135** which forms a final movable member of the crank mechanism. When the crank mechanism is rotationally driven by the driving motor **111**, the piston **135** is caused to linearly move in the axial direction of the hammer bit within a cylinder **141**. The power transmitting mechanism **117** mainly includes a gear speed reducing mechanism having a plurality of gears and transmits torque of the driving motor **111** to the tool holder **137**. Thus, the tool holder **137** is caused to rotate in a vertical plane and then the hammer bit **119** held by the tool holder **137** is also caused to rotate. Further, the constructions of the motion converting mechanism **113** and the power transmitting mechanism **117** are well known in the art and therefore their detailed description is omitted.

The striking mechanism **115** mainly includes a striking element in the form of a striker **143** that is slidably disposed within the bore of the cylinder **141** together with the piston **135**, and an intermediate element in the form of an impact bolt **145** that is slidably disposed within the tool holder **137**. The striker **143** is driven via air spring action (pressure fluctuations) of an air chamber **141***a* of the cylinder **141** by sliding movement of the piston **135**. The striker **143** then collides with (strikes) the impact bolt **145**. As a result, a striking force caused by the collision is transmitted to the hammer bit **119** via the impact bolt **145**.

An operation mode switching dial **147** is mounted on a top cover **107***a* of the crank housing **107** and can be appropriately operated by a user in order to switch the hammer drill **101** between hammer mode and hammer drill mode. In hammer mode, an operation is performed on a workpiece by applying only a striking force to the hammer bit **119** in the axial direction, and in hammer drill mode, an operation is performed on a workpiece by applying a striking force in the axial direction and a rotating force in the circumferential direction to the hammer bit **119**. The operation mode switching between hammer mode and hammer drill mode is a known technique and not directly related to the present invention, and therefore their detailed description is omitted.

In the hammer drill **101** constructed as described above, when the driving motor **111** is driven, the rotating output of the motor is converted into linear motion via the motion converting mechanism **113** and then causes the hammer bit **119** to perform linear movement or striking movement in the axial direction via the striking mechanism **115**. Further, in addition to the above-described striking movement, rotation is transmitted to the hammer bit **119** via the power transmitting mechanism **117** which is driven by the rotating output of the driving motor **111**. Thus, the hammer bit **119** is caused to rotate in the circumferential direction. Specifically, during operation in hammer drill mode, the hammer bit **119** performs striking movement in the axial direction and rotation in the circumferential direction, so that a hammer drill operation is performed on the workpiece. During operation in hammer mode, torque transmission of the power transmitting mechanism **117** is interrupted by a clutch. Therefore, the hammer bit **119** is caused to perform only striking movement in the axial direction, so that a hammering operation is performed on the workpiece.

During the above-described hammering or hammer drill operation, in the body **103**, not only impulsive and cyclic vibration is caused in the axial direction of the hammer bit **119**, but also vibration is caused in a direction transverse to the axial direction. Now, a vibration-proofing structure is explained which serves to prevent or reduce transmission of vibration from the body **103** to the handgrip **109** designed to be held by a user.

FIG. **3** shows the outer housing **102** that covers the body **103**, and the handgrip **109** mounted to the outer housing **102**. As clearly seen from a comparison between FIG. **3** and FIG. **1**, the outer housing **102** covers a region of the body **103** other than the motor housing **105**. Further, naturally, parts to be operated by a user, and more specifically, a chuck **149** which is disposed in a front end region of the tool holder **137** in order to detachably mount the hammer bit **119** to the tool holder **137**, and the operation mode switching dial **147**, are exposed from the outer housing **102**.

The outer housing **102** is generally L-shaped as viewed from the side and has a generally cylindrical front part **102**F extending substantially horizontally in the axial direction of the hammer bit **119** and an oblong rear part **102**R extending downward from a rear end of the front part **102**F. The outer housing **102** is split into two parts, or the front part **102**F and the rear part **102**R, in the axial direction of the hammer bit **119**. A parting line (mating face) is shown and designated by L in FIG. **3**. In the following description, the front part **102**F is referred to as a front housing part and the rear part **102**R as a rear housing part. In order to assemble the front and rear housing parts **102**F, **102**R together, mating faces L (a rear surface of the front housing part **102**F and a front surface of the rear housing part **102**R) are butted with each other, and in this state, a plurality of front and rear connecting bosses **151***a*, **151***b* formed on the outer peripheries of the front and rear housing parts are clamped and connected together by screws **151**. The front and rear housing parts **102**F, **102**R are features that correspond to the "plurality of split elements" according to this invention.

The outer housing **102** constructed as described above is connected to the body **103** via vibration-proofing first to fourth elastic rubbers **153**, **155**, **157**, **159** and can move with respect to the body **103** in the axial direction of the hammer bit **119** and in a vertical direction and a lateral direction which are transverse to the axial direction. In other words, the outer housing **102** is supported via the first to fourth elastic rubbers **153**, **155**, **157**, **159** in no contact with an outer surface of the body **103** (in a floating state). The elastic rubbers **153**, **155**, **157**, **159** are now explained below.

As for the first elastic rubber **153**, as shown in FIGS. **4** and **5**, a total of four upper and lower, right and left elastic rubbers are disposed between an upper portion of the front surface of the rear housing part **102**R and an upper portion of the rear end surface of the crank housing **107**, on the upper and lower, right and left sides with respect to the axis of the hammer bit **119**. Each of the first elastic rubbers **153** has a cylindrical form, and is housed and held in a generally cylindrical part **161** formed on the rear housing part **102**R. Further, a front surface of the first elastic rubber **153** is held in surface contact with an upper portion of the rear end surface of the crank housing **107**. Thus, by frictional force between the contact surfaces, the first elastic rubber **153** is prevented from moving with respect to the crank housing **107**.

As shown in FIGS. **4** and **6**, a total of two right and left second elastic rubbers **155** are disposed between a lower portion of the front surface of the rear housing part **102**R and a lower portion of the rear surface of the motor housing **105**, on the right and left sides of a vertical line perpendicular to the axis of the hammer bit **119**. Each of the second elastic rubbers **155** has a cylindrical form, and is housed and held in a generally cylindrical part **163** formed in the rear housing part **102**R. A front surface of the second elastic rubber **155** is held in surface contact with a rear end surface of a pin-like protrusion **105***a* of the motor housing **105** which is loosely fitted into the cylindrical part **163**. Thus, by frictional force between the contact surfaces, the second elastic rubber **155** is prevented from moving with respect to the motor housing **105**.

As shown in FIGS. **5** and **7**, a total of four upper and lower, right and left third elastic rubbers **157** are disposed between a rear surface of a radial wall surface of the front housing part **102**F and a head of a screw **152** which connects a front part and a rear part of the barrel **106**, on the upper and lower, right and left sides with respect to the axis of the hammer bit **119**. Each of the third elastic rubbers **157** has a cylindrical form, and is housed and held in a generally cylindrical part **165** formed on the front housing part **102**F. Further, a rear surface of the third elastic rubber **157** is held in surface contact with the head of the screw **152**. Thus, by frictional force between the contact surfaces, the third elastic rubber **157** is prevented from moving with respect to the barrel **106**.

In order to assemble the split front and rear housing parts **102**F, **102**R into the outer housing **102**, the front housing part **102**F is fitted onto the barrel **106** from the front, and the rear housing part **102**R is fitted onto the crank housing **107** and the motor housing **105** from the rear, so that the housing parts **102**F, **102**R are opposed to each other, and in this state, the screws **151** are threadably inserted into the connecting bosses **151***a*, **151***b* of the housing parts **102**F, **102**R and tightened. At this time, the above-described first to third elastic rubbers **153**, **155**, **157** are pressed against the crank housing **107**, the motor housing **105** and the barrel **106** in the axial direction of the hammer bit **119** (the mating direction of the outer housing **102**). Specifically, when the outer housing **102** is mounted to the body **103**, the first to third elastic rubbers **153**, **155**, **157** are elastically held between the outer housing **102** and the body **103**. In this case, the first to third elastic rubbers **153**, **155**, **157** are held by the associated cylindrical parts **161**, **163**, **165** formed on the outer housing **102**, which facilitates mounting of the first to third elastic rubbers **153**, **155**, **157**.

The above-described first to third elastic rubbers **153**, **155**, **157** serve to reduce transmission of vibration from the body **103** to the outer housing **102** in the vertical direction and the lateral direction transverse to the axial direction of the hammer bit **119**. The first to third elastic rubbers **153**, **155**, **157** are features that correspond to the “first elastic element” according to this invention.

The hammer drill **101** according to this embodiment has a dynamic vibration reducer **171** for reducing vibration which is caused in the body **103** in the axial direction of the hammer bit **119**, and the fourth elastic rubber **159** is mounted to the dynamic vibration reducer **171**. As shown in FIG. **5**, the dynamic vibration reducer **171** mainly includes an elongate hollow dynamic vibration reducer body in the form of a cylindrical element **172**, a weight **173** disposed within the cylindrical element **172** and elastic elements in the form of biasing springs **174** which are disposed on the front and rear sides of the weight **173** in its longitudinal direction in order to connect the weight **173** and the cylindrical element **172**. The dynamic vibration reducers **171** thus constructed are disposed on the right and left side surfaces of the crank housing **107** in the body **103** on the opposite sides of the axis of the hammer bit **119**, and mounted parallel to each other such that the weight **173** moves in the axial direction of the hammer bit **119**. The dynamic vibration reducer **171** forms a vibration reducing mechanism in which the weight **173** connected to the cylindrical element **172** via the biasing springs **174** moves opposite to the direction of vibration which is caused in the body **103** in the axial direction of the hammer bit **119**, so that vibration of the body **103** is reduced.

The fourth elastic rubber **159** has a ring-like form, and as shown in FIGS. **5**, **8** and **9**, a total of four elastic rubbers **159** are provided and fitted onto the front and rear of the cylindrical element **172** of each of the right and left dynamic vibration reducers **171**. An arcuate engagement part **167** is formed in a region of an inner surface of each of the front and rear housing parts **102**F, **102**R of the outer housing **102** which faces a side region of the fourth elastic rubber **159**, and the side surface of the fourth elastic rubber **159** is elastically engaged with the engagement part **167** in surface contact. With such a construction, the fourth elastic rubber **159** serves to reduce transmission of vibration from the body **103** to the outer housing **102** in the vertical direction and the lateral direction which are transverse to the axis of the hammer bit **119**. The fourth elastic rubber **159** is a feature that corresponds to the “first elastic element” according to this invention.

As shown in FIG. **2**, a sleeve **131** is disposed between an inner surface of the front housing part **102**F of the outer housing **102** and an outer surface of the barrel **106**. The sleeve **131** is held in surface contact with an inner circumferential surface of the front housing part **102**F and elastically held in contact with an outer circumferential surface of the barrel **106** via two front and rear O-rings **133**. The O-ring **133** is made of rubber and serves to position the outer housing **102** in its radial direction (in a direction transverse to the axial direction of the hammer bit **119**) with respect to the barrel **106**. Further, the O-ring **133** elastically deforms in the radial direction so that the outer housing **102** is allowed to move with respect to the barrel **106**. Thus, the O-ring **133** also serves as a vibration-proofing member. The O-ring **133** is a feature that corresponds to the “first elastic element” according to this invention.

As shown in FIGS. **1** to **3**, the handgrip **109** is generally D-shaped as viewed from the side and has a grip region **109**A extending in the vertical direction transverse to the axial direction of the hammer bit **119**, and connecting regions **109**B, **109**C extending horizontally forward from upper and lower ends of the grip region **109**A. Further, front ends of the upper and lower connecting regions **109**B, **109**C are connected to a rear end of the rear housing part **102**R of the outer housing **102**. The lower connecting region **109**C of the handgrip **109** is connected to a lower end portion of the rear housing part **102**R such that it can rotate on a pivot **121** in the axial direction of the hammer bit **119**. The upper connecting region **109**B is connected to an upper end portion of the rear housing part **102**R via a vibration-proofing compression coil spring **123** such that it can move in the axial direction of the hammer bit **119** with respect to the rear housing part **102**R.

As shown in FIG. **10**, two right and left compression coil springs **123** are disposed on the opposite sides of the axis of the hammer bit **119** such that they can be expanded and compressed in the axial direction of the hammer bit **119**. Each of the compression coil springs **123** is elastically disposed between the handgrip **109** and the rear housing part **102**R, and its one end is held in contact with a spring seating surface on the handgrip **109** side and the other end is held in contact with a spring seating surface on the rear housing part **102**R side. The compression coil springs **123** thus arranged serve to reduce transmission of vibration from the body **103** to the handgrip **109** via the outer housing **102** in the axial direction of the hammer bit **119**. The compression coil spring **123** is a feature that corresponds to the "second elastic element" and the "mechanical spring" according to this invention. Further, the compression coil spring **123** is covered by a dustproof cover **124** disposed between the handgrip **109** and the rear housing part **102**R.

A sliding member in the form of a columnar element **125** is formed on an upper end portion of the handgrip **109** and extends horizontally forward through the compression coil spring **123**. The columnar element **125** slides within a cylindrical member **127** which is formed as a sliding guide on the rear surface of the rear housing part **102**R, so that movement of the handgrip **109** in the axial direction of the hammer bit with respect to the rear housing part **102**R can be stabilized. Further, a stopper bolt **129** is inserted into the columnar element **125** and a head of the stopper bolt **129** comes in contact with a front surface of the cylindrical member **127**, so that an end of rearward movement of the handgrip **109** is defined.

In this embodiment, as described above, the outer housing **102** covering the body **103** is connected to the body **103** via the first to third elastic rubbers **153**, **155**, **157** such that it can move in the axial direction of the hammer bit **119** with respect to the body **103**, and also connected to the body **103** via the fourth elastic rubber **159** and the O-ring **133** such that it can move in a direction transverse to the axial direction of the hammer bit **119** with respect to the body **103**. With such a construction, as for vibration which is caused in the body **103** by striking the hammer bit **119** and transmitted from the body **103** to the outer housing **102** during hammering or hammer drill operation, vibration in the vertical and lateral directions transverse to the axial direction of the hammer bit **119** is reduced by the fourth elastic rubber **159** and vibration in the axial direction is reduced by the first to third elastic rubbers **153**, **155**, **157**. In this manner, the outer housing **102** is made proof against vibration in all directions, or in the axial direction of the hammer bit and in the vertical and lateral directions transverse to the axial direction.

The handgrip **109** is connected to the outer housing **102** via the compression coil spring **123** such that it can move in the axial direction of the hammer bit **119** with respect to the outer housing **102**. Therefore, vibration in the axial direction of the hammer bit **119** which is transmitted from the outer housing **102** to the handgrip **109** is reduced by the compression coil spring **123**.

As described above, according to this embodiment, as for vibration caused in the body **103**, vibration in the axial direction of the hammer bit **119** is mainly reduced by the compression coil spring **123** which connects the outer housing **102** and the handgrip **109**, and vibration in a direction transverse to the axial direction is reduced by the fourth elastic rubber **159** which connects the body **103** and the outer housing **102**. Thus, the handgrip **109** is made proof against vibration in the axial direction of the hammer bit **119** and in a direction transverse to the axial direction, and further, the fourth elastic rubber **159** for preventing vibration in a direction transverse to the axial direction is designed to have a relatively high spring stiffness by increasing its spring constant. With this construction, the handgrip **109** can be prevented from wobbling in a direction transverse to the axial direction with respect to the body **103**, so that usability can be enhanced.

In this embodiment, as described above, the first to third elastic rubbers **153**, **155**, **157** are disposed between the outer housing **102** and the body **103**, and when the front housing part **102**F and the rear housing part **102**R are clamped and connected together by the screws **151**, the elastic rubbers are held compressed therebetween. Further, vibration of the handgrip **109** in the axial direction of the hammer bit is mainly prevented by the compression coil spring **123**. With this construction, the first to third elastic rubbers **153**, **155**, **157** may be designed such that the elastic rubbers compressed as described above can further compressively deform (can prevent vibration in the axial direction), or such that they cannot further compressively deform (cannot prevent vibration in the axial direction).

Further, in this embodiment, the body **103** has the dynamic vibration reducer **171**. Therefore, the weight **173** and the biasing spring **174** which serve as vibration reducing elements of the dynamic vibration reducer **171** cooperate to actively reduce vibration caused in the body **103** in the axial direction of the hammer bit **119**. Thus, vibration of the body **103** can be prevented.

Second Embodiment of the Invention

A second embodiment of the present invention is now described with reference to FIGS. **11** to **14**. The second embodiment corresponds to the features as defined in claims **1** to **4**. This embodiment relates to a modification to the vibration-proofing structure of the outer housing **102**, and more particularly to a modification to the vibration-proofing structure for preventing vibration in a direction transverse to the axial direction of the hammer bit **119**. Structures of this embodiment other than the vibration-proofing structure, such as an entire structure of the hammer drill **101**, a structure for driving the hammer bit **119**, and a structure for mounting the handgrip **109**, are identical to those in the above-described first embodiment. Therefore, components which are substantially identical to those in the first embodiment are given like numerals as in the first embodiment and are not described or briefly described.

As shown in FIG. **12**, the outer housing **102** is elastically connected to the body **103** via the vibration-proofing first to third elastic rubbers **153**, **155**, **157** (see FIG. **6** as to the second elastic rubber **155**). Further, as shown in FIG. **11**, a front end of the outer housing **102** is connected to the barrel **106** via the sleeve **131** and the O-ring **133**. As shown in FIG. **11**, the lower connecting region **109**C of the handgrip **109** is connected to the lower end portion of the rear housing part **102**R such that it can rotate on the pivot **121** in the axial direction of the hammer bit **119** and the upper connecting region **109**B is connected to the upper end portion of the rear housing part **102**R via the compression coil spring **123** such that it can move in the axial direction of the hammer bit **119** with respect to the rear housing part **102**R. The above-described construction is the same as in the first embodiment.

In this embodiment, the body **103** of the hammer drill **101** is not provided with the dynamic vibration reducer **171** described in the first embodiment. As shown in FIGS. **12** to **14**, fifth elastic rubbers **176** are disposed in right and left side regions of the crank housing **107** in the body **103**, and the outer housing **102** is connected to the body **103** via the fifth elastic rubber **176** such that it can move in a direction transverse to the axial direction of the hammer bit **119** with respect to the body **103**. The fifth elastic rubber **176** corresponds to the fourth elastic rubber **159** described in the first embodiment and is a feature that corresponds to the "first elastic element" according to this invention.

A total of four front and rear, right and left fifth elastic rubbers **176** are disposed between right and left outer side surfaces of the crank housing **107** and right and left inner side surfaces of the front housing part **102**F of the outer housing **102** which face each other. Each of the fifth elastic rubbers **176** is cylindrically-shaped, and housed and held within a generally circular cylindrical part **177** which is formed on the crank housing **107** and has a lateral opening. In this state, part of the fifth elastic rubber **176** protrudes from the cylindrical part **177**. The protruding end surface of the fifth elastic rubber **176** is held in surface contact with a protrusion **178** formed on the inner side of the front housing part **102**F. Thus, by frictional force between the contact surfaces, the fifth elastic rubber **176** is prevented from moving with respect to the front housing part **102**F.

According to this embodiment constructed as described above, the fifth elastic rubber **176** can prevent vibration of the outer housing **102** by reducing vibration caused in the body **103** in the lateral direction transverse to the axial direction of the hammer bit **119**. Further, the other effects of this embodiment are the same as the effects of the first embodiment.

In this embodiment, with the construction in which the fifth elastic rubber **176** is held by the cylindrical part **177** of the crank housing **107**, the fifth elastic rubber **176** can be prevented from slipping off when assembling the front housing part **102**F and the rear housing part **102**R, so that the assembling operation can be easily performed. The location of the cylindrical part **177** may be changed from the crank housing **107** side to the outer housing **102** side.

Third Embodiment of the Invention

A third embodiment of the present invention is now described with reference to FIGS. **15** to **18**. The third embodiment corresponds to the features as defined in claims **5** to **7**. As shown in FIG. **15**, a hammer drill **201** according to this embodiment mainly includes an outer housing **202** that forms an outer shell of the hammer drill **201**, a body **203** that is covered by the outer housing **202**, a hammer bit **219** detachably coupled to a front end region (on the left as viewed in the drawings) of the body **203** via a hollow tool holder **237**, and a handgrip **209** designed to be held by a user and connected to the outer housing **202** on the side opposite to the hammer bit **219**. The hammer bit **219** is held by the tool holder **237** such that it is allowed to linearly move with respect to the tool holder in its axial direction. The outer housing **202**, the body **203**, the hammer bit **219** and the handgrip **209** are features that correspond to the "outer shell housing", the "tool body", the "tool bit" and the "handle", respectively, according to the present invention. Further, for the sake of convenience of explanation, the side of the hammer bit **219** is taken as the front and the side of the handgrip **209** as the rear.

The body **203** includes a motor housing **205** that houses a driving motor **211**, and a crank housing **207** including a barrel **206** that houses a motion converting mechanism, a striking mechanism and a power transmitting mechanism which are not shown. The crank housing **207** is designed such that its regions other than the barrel **206** are housed in the motor housing **205**, and is connected to the motor housing **205**. The driving motor **211** is disposed such that its rotation axis runs in a vertical direction (vertically as viewed in FIG. **15**) substantially perpendicular to a longitudinal direction of the body **203** (the axial direction of the hammer bit **219**).

The motion converting mechanism appropriately converts torque of the driving motor **211** into linear motion and then transmits it to the striking mechanism, so that the hammer bit **219** is caused to perform striking movement in its axial direction via the striking mechanism. The motion converting mechanism and the striking mechanism are features that correspond to the "striking mechanism part" according to this invention. Further, the power transmitting mechanism appropriately reduces the speed of torque of the driving motor **211** and transmits it to the hammer bit **219** via the tool holder **237**, so that the hammer bit **219** is caused to rotate in its circumferential direction. Specifically, in hammer drill mode, the hammer bit **219** performs striking movement in the axial direction and rotation in the circumferential direction so that a hammer drill operation is performed on a workpiece. In hammering mode, torque transmission of the power transmitting mechanism is interrupted by the clutch. Therefore, the hammer bit **219** performs only the striking movement in the axial direction so that a hammering operation is performed on a workpiece. Further, the driving motor **211** is driven when a user depresses a trigger **209***a* disposed on the handgrip **209**.

A vibration-proofing structure for preventing or reducing transmission of vibration from the body **203** to the handgrip **209** designed to be held by a user during hammering or hammer drill operation is now explained with reference to FIGS. **15** to **19**. In this embodiment, the handgrip **209** and the outer housing **202** may be formed in one piece, or they may be separately formed and integrally connected to each other. The outer housing **202** is connected to the body **203** via a vibration-proofing compression coil spring **281** such that it can move in the axial direction of the hammer bit **219** with respect to the body **203**, and also connected to the body **203** via a plurality of vibration-proofing rubber rings **283** such that it can move in the vertical and lateral directions transverse to the axial direction of the hammer bit **219** with respect to the body **203**. The rubber rings **283** and the compression coil spring **281** are features that correspond to the "first elastic element" and the "second elastic element", respectively, according to this invention.

The handgrip **209** is generally D-shaped as viewed from the side and has a grip region **209**A extending in the vertical direction transverse to the axial direction of the hammer bit **219**, and connecting regions **209**B, **209**C extending substantially horizontally forward from upper and lower ends of the grip region **209**A. Further, front ends of the upper and lower connecting regions **209**B, **209**C are integrally connected to a rear end of the outer housing **202**. As shown in FIG. **15**, the compression coil spring **281** is elastically disposed between a front surface of an upper end portion of the outer housing **202** to which the handgrip **209***a* is connected, and a rear surface of a rear upper end portion of the crank housing **207** in the body **203**. In this state, the compression coil spring **281** can be expanded and compressed in the axial direction of the hammer bit **119**. One end of the compression coil spring **281** is held in contact with a spring receiving part **202***a* on the outer housing **202** and the other end is held in contact with a spring receiving part **207***a* on the crank housing **207**. The compression coil spring **281** thus arranged serves to reduce transmission of vibration from the body **203** to the handgrip **209** in the axial direction of the hammer bit **219**.

The compression coil spring **281** exerts a forward biasing force on the crank housing **207**, and thus the handgrip **209** and the outer housing **202** are subjected to a relatively rearward biasing force. Therefore, as shown in FIG. **15**, a stopper ring **282** made of rubber or resin is disposed between an outer front surface **205***a* of the motor housing **205** in the body **203** and a stepped surface **202***b* formed on the inner surface of the outer housing **202** in the radial direction and facing the outer front surface **205***a*. With this construction, an initial positional relation between the outer housing **202** and the body **203** is defined.

As shown in FIGS. **16** to **19**, the rubber rings **283** are fitted onto both axial ends of each of elongate pin members **284** and retained via respective rubber ring retainers **285**. The pin member **284** is a feature that corresponds to the "rod-like member" according to this invention. Two right and left elongate cylindrical members **286** are disposed on the underside (outer surface) of a bottom plate **207***b* of the crank housing **207** on the opposite sides of the axis of the hammer bit **219** and extend parallel to each other in the axial direction of the hammer bit **219**. The right and left cylindrical members **286** may be integrally formed with or fixedly mounted to the crank housing **207**. Each of the pin members **284** extends through the associated cylindrical member **286**, and as shown in FIG. **19**, the pin member **284** is supported at the both ends of the cylindrical member **286** via sliding bearings **287** such that it can slide in the axial direction of the hammer bit **219** with respect to the cylindrical member **286**. The both axial ends of the pin member **284** protrude from the cylindrical member **286** to the outside, and the rubber rings **283** are coaxially mounted onto the protruding ends of the pin member **284** via the rubber ring retainers **285**. Thus, a total of four front and rear, right and left rubber rings **283** are disposed in a lower region outside the crank housing **207**.

As shown in FIG. **15**, four cylindrical holding parts **288** are formed in the outer housing **202** and house and hold the four rubber rings **283**. Each of the rubber rings **283** is held in surface contact with an inner circumferential surface of the cylindrical holding part **288** and connected to the cylindrical holding part **288** such that it can elastically deform in the radial direction. In this manner, the outer housing **202** is connected to the body **203** via the four rubber rings **283** disposed side by side substantially on the same horizontal plane, in the vicinity of the bottom of the crank housing **207** or substantially in a middle region of the body **203** in the vertical direction, such that it can move in a direction (vertical and lateral directions) transverse to the axial direction of the hammer bit **219** with respect to the body **203**.

Further, both axial end surfaces of the pin member **284** (end surfaces of the rubber ring retainers **285**) are held in contact with the bottom of the cylindrical holding part **288**. Therefore, the outer housing **202** and the pin member **284** are prevented from moving in the axial direction of the hammer bit **219** with respect to each other and thus form an integrated structure. Therefore, the pin member **284** moves in the axial direction of the hammer bit **219** together with the outer housing **202** with respect to the crank housing **207** and serves as a guide rail for guiding the movement of the outer housing **202**.

As shown in FIG. **16**, an opening **286***a* is formed in a region of an upper surface of the cylindrical member **286** which faces an inner surface of the bottom plate **207***b* of the crank housing **207** (the inside of the housing), and lubricant (grease) within the crank housing **207** is led into the cylindrical member **286** through the opening **286***a*. Thus, a sliding surface between the pin member **284** and the cylindrical member **286** (the sliding bearing **287**) is lubricated with lubricant, so that smoothness of their sliding movement and their durability can be improved. Further, an oil seal **289** for preventing leakage of lubricant is provided on the outer side of the sliding bearing **287**.

As shown in FIG. **15**, like in the first embodiment, the outer housing **202** for covering the body **203** covers a region of the body **203** other than a lower region of the motor housing **205**. Further, parts to be operated by a user, and more specifically, a chuck **249** which is disposed in a front end region of the tool holder **237** in order to removably attach the hammer bit **219** to the tool holder **237**, and an operation mode switching dial **247** for switching the operation mode of the hammer bit **219**, are exposed from the outer housing **202**.

A dynamic vibration reducer **271** is mounted on each of the right and left side surfaces of the crank housing **207**. Although not shown, the dynamic vibration reducer **271** has the same construction as the dynamic vibration reducer **171** which is described in the first embodiment. The dynamic vibration reducer **271** forms a vibration reducing mechanism in which the weight connected to the cylindrical element via an elastic element in the form of the biasing spring moves opposite to the direction of vibration which is caused in the body **203** in the axial direction of the hammer bit **219**, so that vibration of the body **203** is reduced.

In this embodiment, as described above, the outer housing **202** covering the body **203** is integrally formed with the handgrip **209**. Further, the outer housing **202** is connected to the body **203** via the compression coil spring **281** such that it can move in the axial direction of the hammer bit **219** with respect to the body **203**, and also connected to the body **203** via the rubber ring **283** such that it can move in the vertical and lateral directions transverse to the axial direction of the hammer bit **219** with respect to the body **203**. With such a construction, as for vibration which is caused in the body **203** by striking the hammer bit **219** and transmitted to the outer housing **202** during hammering or hammer drill operation, vibration in the axial direction of the hammer bit **219** is reduced by the compression coil spring **281** and vibration in the vertical and lateral directions transverse to the axial direction of the hammer bit **219** is reduced by the rubber rings **283**. In this manner, the outer housing **202** and the handgrip **209** are made proof against vibration in all directions, or in the axial direction of the hammer bit **219** and in the vertical and lateral directions transverse to the axial direction of the hammer bit.

Specifically, according to this embodiment, like in the above-described first embodiment, the handgrip **209** to be held by a user is made proof against vibration in the axial direction of the hammer bit **209** and in a direction transverse to the axial direction, and the rubber ring **283** for preventing vibration in a direction transverse to the axial direction is designed to have a relatively high spring stiffness by increasing its spring constant. With this construction, the handgrip **209** is prevented from wobbling in a direction transverse to the axial direction with respect to the body **203**, so that usability can be enhanced.

Further, the rubber ring **283** in this embodiment may be designed to prevent vibration not only in a direction transverse to the axial direction of the hammer bit **219** but also in the axial direction of the hammer bit.

Further, in this embodiment, the pin member **284** is provided on the crank housing **207** and slidably extends through the cylindrical member **286** in the axial direction of the hammer bit **219**, and the outer housing **202** moves together with the pin member **284** in the axial direction of the hammer bit **219** with respect to the crank housing **207**. Specifically, the pin member **284** serves as a guide rail for guiding the movement of the outer housing **202** with respect to the crank housing **207**. Thus, the outer housing **202** can move with respect to the crank housing **207** with stability, so that usability of the impact tool can be improved. Further, with the construction in which lubricant within the crank housing **207** is supplied to the sliding surface between the pin member **284** and the cylindrical member **286**, smoothness and durability of the sliding parts can be effectively enhanced.

In the first to third embodiments, the hammer drills **101**, **201** are explained as representative examples of the impact tool, but this invention can also be applied to a hammer in which the hammer bits **119**, **219** perform only striking movement.

In view of the above-described invention, the following aspects can be provided.

Aspect 1

"The impact tool as defined in any one of claims **2** to **4**, comprising a plurality of the first elastic elements which are disposed symmetrically with respect to an axis of the tool bit."

Aspect 2

"The impact tool as defined in claim **3**, wherein the first elastic element is held by a cylindrical part formed on at least one of the tool body and the outer shell housing when the split elements are connected to each other."

Aspect 3

"The impact tool as defined in claim **8**, wherein the dynamic vibration reducer has a columnar element, a weight which is housed within the cylindrical element and can linearly move in an axial direction of the tool bit, and an elastic element which connects the weight and the cylindrical element, and

the first elastic element is disposed on an outer circumferential surface of the cylindrical element and elastically held in contact with an inner surface of the outer shell housing."

Aspect 4

"The impact tool as defined in any one of claims **5** to **7**, wherein a plurality of the first elastic elements are disposed side by side on one horizontal plane, in a middle region of the tool body in a vertical direction transverse to the axial direction of the tool bit."

Aspect 5

"The impact tool as defined in claim **6** or **7**, wherein lubricant in the tool body is supplied to a sliding part between the rod-like member and the tool body."

DESCRIPTION OF NUMERALS

101 hammer drill (impact tool)
102 outer housing (outer shell housing)
102F front housing part (split element)
102R rear housing part (split element)
103 body (tool body)
105 motor housing
105*a* pin-like protrusion
106 barrel
107 crank housing
107*a* top cover
109 handgrip (handle)
109A grip region
109B upper connecting region
109C lower connecting region
109*a* trigger
111 driving motor (motor)
113 motion converting mechanism (striking mechanism part)
115 striking mechanism (striking mechanism part)
117 power transmitting mechanism
119 hammer bit (tool bit)
121 pivot
123 compression coil spring (second elastic element)
124 dustproof cover
125 columnar element
127 cylindrical member
129 stopper bolt
131 sleeve
133 O-ring (first elastic element)
135 piston
137 tool holder
141 cylinder
141*a* air chamber
143 striker
145 impact bolt
147 operation mode switching dial
149 chuck
151 screw
151*a* front connecting boss
151*b* rear connecting boss
152 screw
153 first elastic rubber (first elastic member)
155 second elastic rubber (first elastic member)
157 third elastic rubber (first elastic member)
159 fourth elastic rubber (first elastic member)
161 cylindrical part
163 cylindrical part
165 cylindrical part
167 engagement part
171 dynamic vibration reducer
172 cylindrical element
173 weight
174 biasing spring
176 fifth elastic rubber (first elastic member)
177 cylindrical part
178 protrusion
201 hammer drill (impact tool)
202 outer housing (outer shell housing)
202*a* spring receiving part
202*b* stepped surface
203 body
205 motor housing
205*a* outer front surface
206 barrel
207 crank housing
207*a* spring receiving part
207*b* bottom plate
209 handgrip (handle)
209A grip region
209B upper connecting region
209C lower connecting region
209*a* trigger
211 driving motor
219 hammer bit (tool bit)
237 tool holder

247 operation mode switching dial
249 chuck
281 compression coil spring (second elastic element)
282 stopper ring
283 rubber ring (first elastic element)
284 pin member (rod-like member)
285 rubber retainer
286 cylindrical member
286*a* opening
287 sliding bearing
288 cylindrical holding part
289 oil seal

The invention claimed is:

1. An impact tool which linearly drives a tool bit in an axial direction of the tool bit to cause the tool bit to perform a predetermined hammering operation, comprising:
- a motor,
- a striking mechanism part that is driven by the motor and causes the tool bit to linearly move,
- a tool body that houses the motor and the striking mechanism part,
- an outer shell housing that covers at least part of the tool body,
- a first elastic element that elastically connects the outer shell housing to the tool body such that the outer shell housing can move in a direction transverse to the axial direction of the tool bit with respect to the tool body,
- a handle designed to be held by a user,
- a second elastic element that connects the handle to the outer shell housing such that the handle can move in the axial direction of the tool bit with respect to the tool body,
  - wherein the tool body has a barrel extending in the axial direction of the tool bit, the first elastic element is interveningly disposed between an outer circumferential surface of the barrel and an inner circumferential surface of the outer shell housing which covers the barrel, and the first elastic element positions the outer shell housing in a radial direction with respect to the tool body, and
  - wherein the striking mechanism comprises a motion converting element and a striking element, the striking element is at least partly housed by the barrel of the tool body,
- a plurality of third elastic elements that can elastically deform in the direction transverse to the axial direction of the tool bit, and
- a rod-like member which is provided in the tool body and slidably extends through the tool body in the axial direction of the tool bit, wherein:
  - the outer shell housing is connected to the tool body via at least the plurality of third elastic elements and the second elastic element,
  - the rod-like member serves as a guide rail for guiding movement of the outer shell housing in the axial direction of the tool bit with respect to the tool body,
  - the rod-like member extends in the axial direction of the tool bit and an elastic element of the plurality of third elastic elements is mounted to each end of the rod-like member, and
  - the tool body comprises a first hole that is disposed close to the tool bit and a second hole that is disposed remote from the tool bit in the axial direction of the tool bit, and the rod-like member is provided to penetrate the first and second holes.

2. The impact tool as defined in claim **1**, wherein the handle has a grip region extending in a direction transverse to the axial direction of the tool bit and one end of the grip region in an extending direction is connected to the outer shell housing by the second elastic element comprising a mechanical spring.

3. The impact tool as defined in claim **1**, wherein the outer shell housing is split into a plurality of split elements in the axial direction of the tool bit and formed by connecting the split elements to each other.

4. The impact tool as defined in claim **1**, comprising a dynamic vibration reducer which is provided in the tool body and reduces vibration of the tool body in the axial direction of the tool bit.

5. An impact tool, which linearly drives a tool bit in an axial direction of the tool bit to cause the tool bit to perform a predetermined hammering operation, comprising:
- a motor,
- a striking mechanism part that is driven by the motor and causes the tool bit to linearly move,
- a tool body that houses the motor and the striking mechanism part,
- an outer shell housing that covers at least part of the tool body,
- a handle that is designed to be held by a user and integrally formed on an opposite side of the outer shell housing from the tool bit,
- a plurality of first elastic elements that can elastically deform in a direction transverse to the axial direction of the tool bit,
- a second elastic element that can elastically deform in the axial direction of the tool bit, and
- a rod-like member which is provided in the tool body and slidably extends through the tool body in the axial direction of the tool bit, wherein:
  - the outer shell housing is connected to the tool body via at least the plurality of first elastic elements and the second elastic element,
  - the rod-like member serves as a guide rail for guiding movement of the outer shell housing in the axial direction of the tool bit with respect to the tool body,
  - the rod-like member extends in the axial direction of the tool bit and a first elastic element of the plurality of first elastic elements is mounted to each end of the rod-like member, and
  - the tool body comprises a first hole that is disposed close to the tool bit and a second hole that is disposed remote from the tool bit in the axial direction of the tool bit, and the rod-like member is provided to penetrate the first and second holes.

6. The impact tool as defined in claim **5**, wherein the rod-like member and the outer shell housing are connected to each other via the plurality of first elastic elements.

7. The impact tool as defined in claim **5**, comprising a dynamic vibration reducer which is provided in the tool body and reduces vibration of the tool body in the axial direction of the tool bit.

8. The impact tool as defined in claim **5**, wherein the striking mechanism comprises a motion converting element and a striking element, and the striking element is at least partly housed by the tool body.

9. An impact tool, which linearly drives a tool bit in an axial direction of the tool bit to cause the tool bit to perform a predetermined hammering operation, comprising:
- a motor,
- a striking mechanism part that is driven by the motor and causes the tool bit to linearly move,
- a tool body that houses the motor and the striking mechanism part,

an outer shell housing that covers at least part of the tool body,

a handle that is designed to be held by a user and integrally formed on an opposite side of the outer shell housing from the tool bit,

a plurality of first elastic elements that can elastically deform in a direction transverse to the axial direction of the tool bit,

a second elastic element that can elastically deform in the axial direction of the tool bit, and

a rod-like member which is provided in the tool body and slidably extends through the tool body in the axial direction of the tool bit, wherein:

the outer shell housing is connected to the tool body via at least the plurality of first elastic elements and the second elastic element,

the rod-like member serves as a guide rail for guiding movement of the outer shell housing in the axial direction of the tool bit with respect to the tool body,

the rod-like member extends in the axial direction of the tool bit and a first elastic element of the plurality of first elastic elements is mounted to each end of the rod-like member, and

the rod-like member is provided with two elongate members, and the two elongate members are disposed on opposite sides of the axis of the tool bit to each other.

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